

Research Article

Pre Extension Demonstration and Evaluation of Faba Bean Technologies at Highlands of Guji Zone, Oromia, Ethiopia

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Abstract

When newly released varieties from agricultural research centers are demonstrated and marketed to farmers, they have a significant impact on crop productivity. This research investigates yield performance and profitability of the Matti faba bean variety released under farmer conditions. The trial was conducted on a sample of 14 farmers land on 10m x 10m area. The newly released Matti variety was demonstrated with the Walki variety serving as a standard check. Mini-field day and training extension approaches were used to promote faba bean technology. Measurement and interviews were used to collect data, and the collected data were analyzed using likert scales, descriptive analysis, and net income. It was found that the Matti and Walki varieties yielded 25.86 and 23.77 qt/ha, respectively. With returns of 81083.93 and 70966.07 birr/ha, respectively, Matti and Walki production is also beneficial for farmers. In the faba bean production, farmers' preferred qualities such as sweetness, number of branches/plant, and disease resistance variety. The finding of this research revealed that the newly released Matti variety was rated highest in faba bean production based on the qualities needed by farmers. The Matti variety is recommended for better faba bean production in highland parts of the Guji zone due to its higher yield, higher profit, and farmer preference. Farmers' preferences for particular qualities should be taken into account when releasing improved faba bean varieties in the study areas.

Keywords: Bore; Demonstration; Farmers' preference; Matti variety

Introduction

Agriculture accounts for the majority of Ethiopia's economy. It supplies the majority of raw materials and investment capital while also accounting for 79% of employment, 34.1% of GDP, and 79% of foreign exchange profits [1]. Despite enormous economic impacts, Ethiopia's agriculture is characterized by low productivity, subsistence farming and traditional production methods [2,3]. The government's main policy in response to Ethiopia's challenges with food security and agricultural productivity is adoption of the strategy Agricultural Development Lead Industrialization (ADLI). According to Ayalew [4] and Daemo [5], the policy encourages the use of better agricultural techniques to boost productivity and production.

Faba bean is the third-most produced pulse crop globally, behind field peas and soybeans, in terms of planted area [6]. Over 60 nations throughout the world have planted faba beans, with China being the top producer, followed by Ethiopia, Egypt, and the United Kingdom [7,8]. According to Rahul *et al.* [9], the two countries with the largest productions of faba beans, China and Ethiopia, accounted for about 28% and 18% of the world's total production in 2022 fiscal year. According to Genetu *et al.* [10], Ethiopia produces 56% of all faba beans produced in Africa, and for the majority of smallholder farmers in the area, it is the main source of protein in their diet.

Favorable soil conditions and an appropriate agro-ecological scenario are the primary factors that contribute to Ethiopia's strong growth and production of grain legume crops [11]. Faba bean is one legume crop and it grows in a number of places, including the Arsi and Bale Highlands, the Central Highlands of Ethiopia, Tigray, North and South Wollo, North and South Gondar, the East and West portions of Gojjam, Wollega, the Guji highlands, Hadiya, Sidama, and Gamo-Gofa [12]. During the 2020–2021 cropping season, more than 4.5 million smallholder farmers produced 1078265.5 metric tons of faba beans on 518466.39 hectares of land [13].

Faba beans are significant crops in Ethiopia for human consumption, animal feed, and sustainable farming methods such as increasing soil fertility by fixing nitrogen. Incorporating faba bean intercropping into integrated pest control can safeguard the primary crop and minimize the use for pesticides, hence promoting environmental sustainability [9,14,15]. Faba beans are high in protein and high in healing-related antioxidants, vitamins, and minerals [11]. Moreover, faba beans are a source of foreign exchange earnings for the nation and a cash crop for farmers [15–18].

In spite of their wider area and agro-ecological coverage, varied importance as food, animal feed, improving soil fertility, and foreign

currency earnings, faba beans are only productive at 2.1 t/ha [13,19] compared to 5.2 t/ha [12,20,21] in Ethiopia. High yield varieties must be used in order to boost faba bean production. To increase faba bean production and help highland farmers of Guji zone, Bore Agricultural Research Center released a stable and high yielding variety called Matti. In order to boost faba bean output and promote faba bean technologies in the promising areas, it is crucial to demonstrate the released varieties on farmers' fields. The objectives of this activity was to examine farmers' feedback for the advancement of faba bean production in highland areas, as well as to evaluate the yield performance of released faba bean technologies and estimate their profitability under farmers' conditions.

Since mid-1960s Ethiopia implemented several extensions approach to boost agricultural sector. During that time the focus was to improve living standards through increased production in agro ecological zones [22]. However, most of the approaches were from top down where farmers' circumstances were overlooked and approaches were failed to be sustainable in improving agricultural sector.

At present, Ethiopia Agricultural Research system followed bottom-up approach where farmers' interest and perception is stepping stone in technology promotion in pre-extension demonstration, pre scaling and cluster extension approaches and services in transferring research technologies to end users [23]. At pre-extension demonstration stage, farmers participated in the research from land preparation to post management in order to approve the importance of the recommended new variety/technology in line with agro-ecology condition. At this stage farmers decision and preference can determine the adoption of the variety. The best variety selected at pre-extension demonstration stage can further popularized through pre-scaling up and large scale approach which can increase surplus production and maximize farmers' benefit [24].

Agricultural research extension used different approaches including demonstration fields (individual approach), Community based seed production (group approach), Cluster based demonstration and Village based demonstration (integrated technology) to promote proven agricultural research technologies. The demand driven agricultural extension and advisory services have significant importance for agricultural development and rural livelihoods transformation [25]. Agricultural extension services are used to improve farming, disseminate information, educate farmers and promote agricultural technologies [26].

This experiment was derived from farmers' intention on released faba bean varieties during variety verification. The aim of breeding is to release the best variety suitable for farmers' circumstance while agricultural research extension is to promote released varieties and technologies in the communities. Hence, this activity used demonstration approach where farmers fully participated on demonstration and promotion of released faba bean technologies (varieties and recommendation). In Ethiopia the role agricultural extension is mainly technology (new variety, new methods of production, new tools, or improved variety/recommendation) promotion which can increase farmers' agricultural production [27]. Therefore, promoting agricultural technologies are important to improve household food security, enhance commercialization and reduce poverty.

Materials and Methods

Farmers and Site Selection

This demonstration was conducted in the Bore and Ana Sora highland areas of Guji zone. The locations were chosen based on their potential for faba bean production. The demonstration included two kebeles from each district, three experimental farmers from each kebele, and two farmer training centers, for a total of 14 experimental fields.

Research Materials and Design

Walki variety was used as standard check to test the newly released Matti variety in 2023/2024 production year. Each variety was sown on a 10 m x 10 m side by side, per selected farmers who served as a replication. The demonstration was conducted employing the recommended spacing between rows and plants of 40 and 10 cm, respectively, and 200 kg of seed and 150 kg of fertilizer (NPS) per hectare.

Technology Demonstration and Promotion Approach

Theoretical and practical trainings were given to farmers to enhance faba bean production and productivity. Farmers and other stakeholders received training on the relevance of the newly Matti variety and production recommendations for faba beans. The farmers also provided advice on the management techniques required for faba bean production during follow-up and monitoring activities. A mini-field day was held to promote faba bean technologies (varieties and recommended practices of faba bean production) in the Guji zone's highlands at the maturity stage of the faba bean demonstration.

Data Collection and Analysis

Measurements and interview techniques were used to gather information on farmers' preferences for specific faba bean varieties and traits, as well as the production costs associated with producing faba beans for this demonstration yield. Descriptive statistics were used to assess the yield data. Net income (NI) was used to assess the profitability of the faba bean varieties that were on demonstrated.

$$TR = q * p \dots\dots\dots (1)$$

Where q= yield obtained (qt/ha) and p farm gate price in birr/ha

$$NI = TR - TVC - FC \dots\dots\dots (2)$$

Where NI = Net income, TR= Total Revenue, TVC= total variable cost and FC= fixed cost

Farmers set their own traits in producing faba bean at their location. Every farmer included in the trial was asked to identify the traits/attributes of the faba bean varieties that were demonstrated. The best variety ranked according to traits farmers identified on a Likert scale of 1–5 (1 very poor, 2 poor, 3 medium, 4 very good, and 5 excellent).

Results and Discussions

Promotion of Faba Bean Technologies in the Highlands of Guji Zone

Apart from being labor-intensive, agricultural production requires production knowledge. Farmers are trained to acquire such

Table1: Promotion of faba technologies at demonstration stage.

Faba bean promotion	SMSs			DAs			Farmers				
	Male	Female	Total	Male	Female	Total	Adult male	Adult female	Youth male	Youth female	Total
Training	10	2	12	14	4	18	98	42	10	10	190
Mini-field day	18	1	19	17	3	20	68	6	5	2	81

SMSs = subject matter specialists, DAs = development agents.

production knowledge. A new faba bean variety called Matti has been made available for the Guji zone's highlands. For this reason, farmers using this new variety need to receive production training. Farmers, development agents, and subject matter experts were therefore provided with theoretical and practical training. A mini-field day was organized to promote the popularity of the Matti variety for potential faba bean production, in addition to training. A wide range of individuals attended the mini-field day (Table 1). Attendees noticed that the Matti variety performed better than the Walki variety in terms of branch count and pod count on mini-field Day.

Yield Performance of Faba Bean Demonstrated Varieties

The yields of the Matti and Walki varieties were higher in Bore with 28.63 qt/ha of Matti and 25.88 of yield per hectare and 22.17qt/ha and 20.96qt/ha in Ana Sora district. This suggests that the Bore district has a little higher potential for producing faba beans in highlands. The demonstration result indicated that the mean yields of Matti and Walki were 25.86 and 23.77 qt/ha, respectively (Table 2). This experiment had a lower result than the previous one, which was done in the same location and produced 40.6 qt/ha and 39.6 qt/ha from Aloshe and Walki, respectively [28]. Furthermore, Gebelcho and Walki provided 33 qt/ha and 27 qt/ha, respectively, in the districts of Bore and Ana Sora, as reported by Kebede and Korji [29]. The yield difference seen in this demonstration within the same area may be attributed to variations in the genetic performance of different varieties, soil factors, and farmer management practices. Nevertheless, this demonstration's yield performance was higher than the national and Oromia regional yields, which were 20.97 qt/ha and 22.82 qt/ha, respectively [30].

Profitability of Faba Bean Production

Beyond the yield farmers need profitability of varieties and it is essential to examine profitability of Matti and Walki in this demonstration. During production, the farm gate price for each variety was estimated to be 5132.14 birr/qt, and the fixed cost of land was 20464.29 birr/ha. Variable costs, such as those associated with seed, fertilizer, land preparation, sowing, weeding, harvesting, threshing, and other expenses, cost farmers 27194.64 birr/ha on faba bean production. The result of net income showed that 81083.93 birr/ha and 70966.07 birr/ha was obtained from Matti and Walki variety production, respectively (Table 3). This indicated that though Matti

Table 2: Yield of demonstrated faba bean varieties.

Districts where demonstration carried out		Yield of Matti variety (qt/ha)	Yield of Walki variety (qt/ha)
Ana Sora	Mean	22.17	20.96
	N	6	6
	Std. Deviation	6.76	6.96
Bore	Mean	28.63	25.88
	N	8	8
	Std. Deviation	4.58	5.17
Total	Mean	25.86	23.77
	N	14	14
	Std. Deviation	6.32	6.28

Table 3: Profitability demonstrated faba bean varieties.

Parameters	N	Minimum	Maximum	Mean	Std. Dev.
Yield of Matti (qt/ha)	14	14.00	35.00	25.86	6.32
Yield of Walki (qt/ha)	14	12.00	30.00	23.77	6.28
Farm gate price each variety (birr/ha)	14	4200	6500	5132.14	717.26
Total variable costs (birr/ha)	14	24250	29700	27194.64	1396.05
Fixed cost (birr/ha)	14	18000	25000	20464.29	3078.86
Total revenue of Walki (birr/ha)	14	77000	165000	118625.00	24362.22
Total revenue of Matti (birr/ha)	14	91000	149500	128742.86	18538.64
Net income of Walki variety (birr/ha)	14	32750	118550	70966.07	24636.40
Net income of Matti variety (birr/ha)	14	47075	99175	81083.93	18052.43

earns more return than Walki, production of both varieties were profitable for farmers in the highlands areas of Guji zone.

Farmers' Preference on Traits and Varieties of Faba Bean

The demonstrated varieties of faba beans were assessed by every experimental farmer. The most important five characteristics in faba bean production that farmers found were sweetness, yield, number of seeds per pod, number of branches per plant, and disease tolerance. In faba bean production, the top three desired qualities were sweetness, number of branches per plant, and disease resistance. Farmers have chosen the Matti variety above the Walki variety for all traits. Compared to the Walki variety, the Matti variety has more branches per plant. Matti variety was placed top, followed by Walki variety, based on the mean score of traits (Table 4). This demonstrated that in the Guji zone's highlands, the new variety Matti was given priority over the variety Walki, which was already in use for production.

Conclusions and Recommendations

New varieties released by research center need to be demonstrated in order to increase agricultural production and productivity. Demonstration is a significant launch event for a large-scale extended production and promotion. In the highland Guji zone districts of Bore and Ana Sora, pre-extension demonstrations of the Matti and Walki faba bean varieties were undertaken. Farmers benefit more from the new variety of Matti production than from Walki variety. The cultivation of the Matti variety and Walki produced a healthy profit for the farmers in the study areas. Farmers in the districts of Bore and Ana Sora determined that the most crucial factors for faba bean production were yield, disease resistance, sweetness, number of branches per plant, and number of seeds per pod. Farmers choose the Matti variety as their favorite trait for growing faba beans. The Matti variety is recommended for large-scale faba bean production in the highlands of the Guji zone due to its higher yield and farmers' choice. It is recommended that farmers should use Matti variety in faba bean production. Farmers' preferences for certain qualities in faba beans should be taken into account in agricultural research while developing new and better varieties in the study areas.

Table 4: Farmers' preference on demonstrated faba bean varieties.

Varieties	Faba bean traits valued by farmers (n=14)					Total	Mean	Rank
	Yield	Disease tolerance	Sweetness	Number of branches/plant	Number of seeds/pod			
Walki	46	48	55	45	47	241	48.2	2
Matti	49	53	56	54	49	261	52.2	1

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